

How New Computational Methods are Changing Social Science

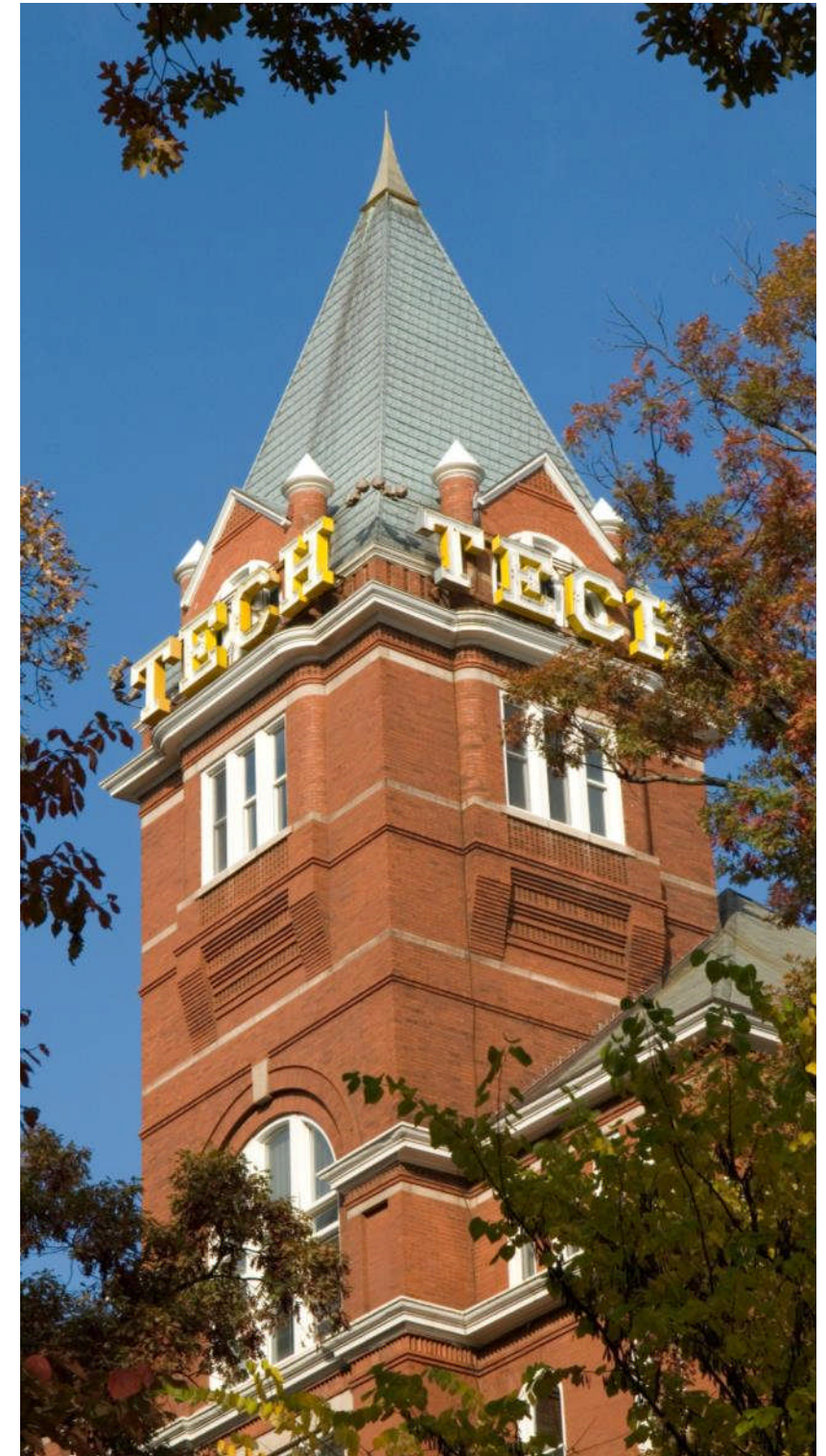
Panel Discussion at HUSO 2016

Ole Berndt, Trier University, Germany

Vijayan K. Asari, University of Dayton, USA

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Introduction: Relevant Trends

- Increase in general computing power available to social scientists
- Decrease in cost of computing
- Increase in mobile computing and network services
- Increase in availability of data from traditional and non-traditional sources

Panel Summary

- Computer scientists have already developed many of the capabilities needed for large scale human social analytics
- Social scientists are often unaware of the computational resources that are already available
 - But computer scientists are often unaware of the needs in the social sciences
 - Computer scientists don't necessarily keep up with the state of theory in social science
- The future of social science research will be dominated by “big data” studies
- The Internet of Things will be a significant source of social science data



Computer Simulation as a Research Method for Social Science

Dr. Jan Ole Berndt

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What is (Computer) Simulation?



A computer simulation is a computation that models the behaviour of some real or imagined system over time (Richard M. Fujimoto)

- **System** Object under study; entities, relationships, and processes that adhere to certain rules

- **Model** Physical object or theoretical construct that mirrors particular properties or relations of another object.

- **Simulation** In a simulation, experiments are conducted using a model to obtain knowledge about the real system.



Computer Simulation in Social Science



- Example 1: *Emergent opinion-making processes*
 - Classic mass media vs. Online Social Networks
 - Media Studies: Manual analysis
 - Computer Linguistics: Automatic analysis
 - Business Informatics: Simulation

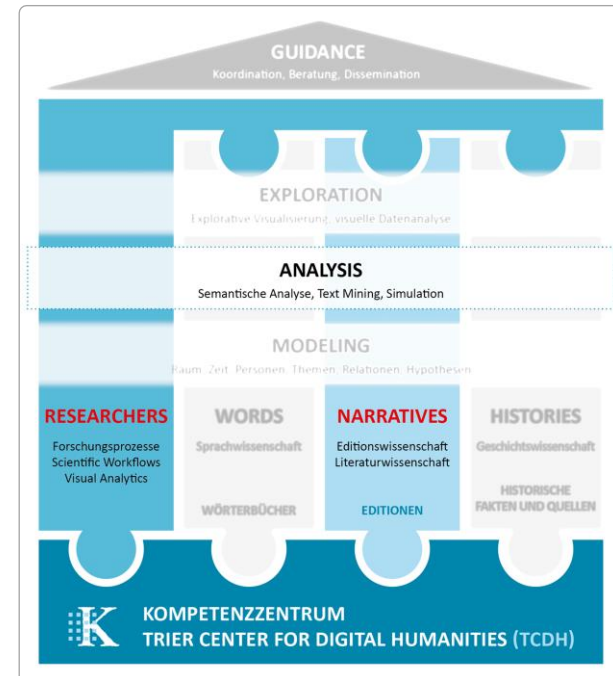
[Timm I.J., Berndt J.O., Lorig F., Barth C., Bucher H.-J. (2016). Dynamic Analysis of Communication Processes using Twitter Data. 2nd International Conference on Human and Social Analytics (HUSO 2016), pp. 14-22.]

- Example 2: *eXplore!*
 - Computer based modeling, analysis, and exploration in eHumanities
 - Literature Studies + Business Informatics
 - Simulating emigration/flight processes of writers and their families from Nazi-Germany (from 1933 onwards)
 - Scientific workflows for Simulation in eHumanities

[Trier Center for Digital Humanities; CIRT: Center for Informatics Research & Technology
Prof. Dr. R. Bergmann, Dr. T. Burch, Dr. V. Hildenbrandt, Prof. Dr. C. Moulin, Prof. Dr. I. J. Timm]



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Simulation Challenges: Tool vs. Method



- Simulation as a Tool
 - „Testing“ of a model
 - Imitation of a real system
 - Demonstration of processes and relations
 - Exploration to find a realistic parameter setup

- Simulation as a Method
 - Formulation of hypotheses
 - Construction of models
 - Design of experiments
 - Result analysis and interpretation

[Timm I.J., Lorig F. (2015). A Survey on Methodological Aspects of Computer Simulation as Research Technique. In: L. Yilmaz et al. (Eds.): Proceedings of the 2015 Winter Simulation Conference, pp. 2704-2715]

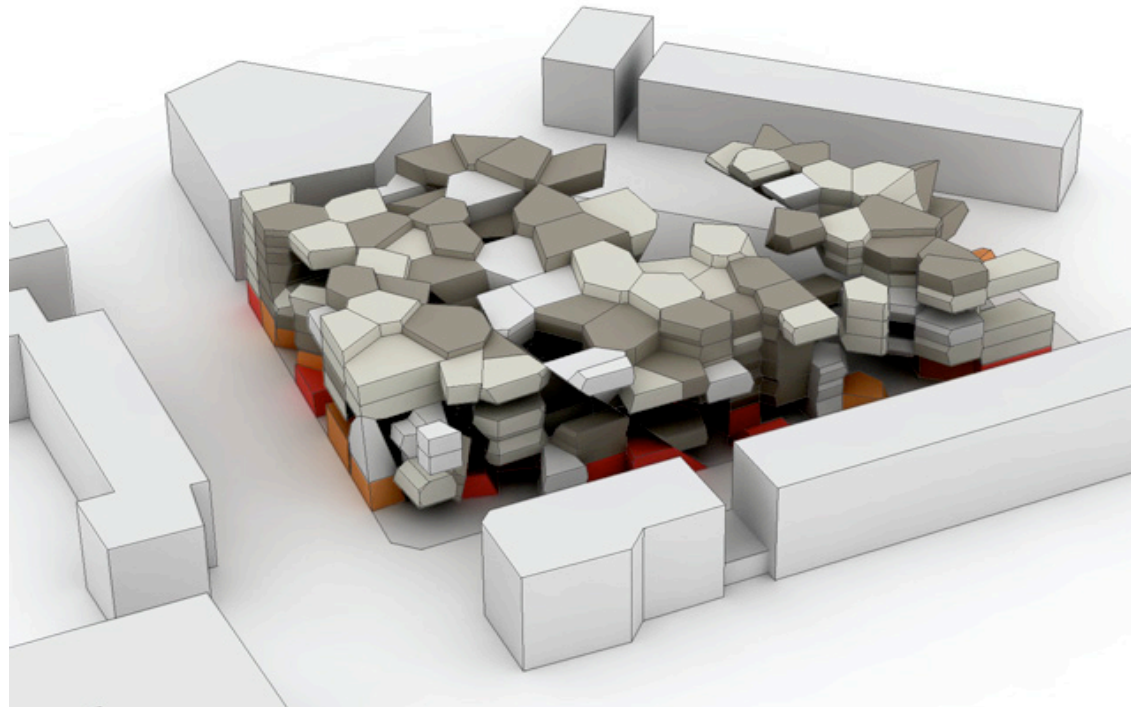
HOW NEW COMPUTATIONAL METHODS ARE CHANGING SOCIAL SCIENCE

Barcelona, November 2016

- Antonio Martín, Seville University, Spain

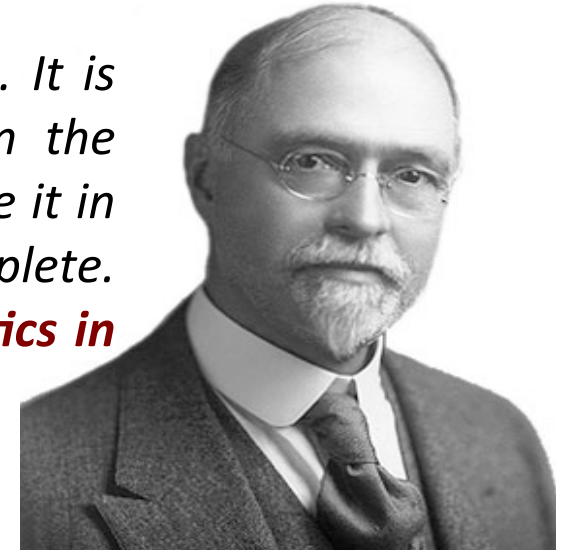


- Introduction.
- Outstanding challenges related.
- Position on computational & social science topic.
- Main open issues.



- The use of mathematics for social and economic analysis dates **back to the 17th century.**
- *Mathematical notation is, as Gibbs said, simply a language. It is **required for the best expression of scientific method** when the relations to be expressed become sufficiently involved to require it in preference to ordinary language, which is less precise and complete. The outlook is bright **for a healthy development of mathematics in the social sciences.***

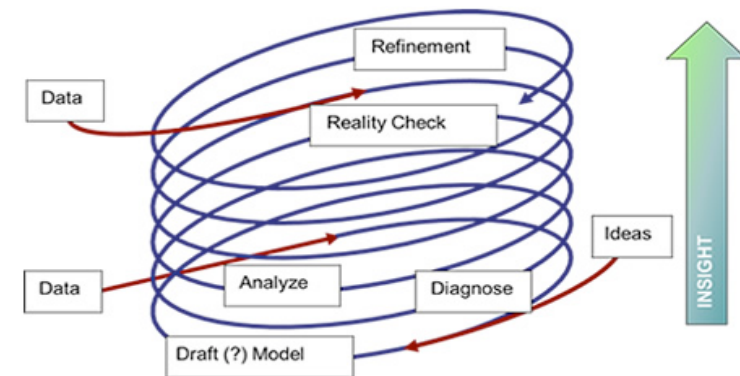
(Irving Fisher - American economist In 1929)



- Social science research draws on the enormous potential of vast amounts of digital data on social interactions made available through digital world.
 - Computational methods take into account people's behavior and collect the little data crumbs we leave behind when you use Facebook, browser searches, mobile apps, etc.
 - Looking these information has given us a new outlook and it is revolutionizing the way we do everything.

Society seen as a complex adaptive system

- Our social behavior seems to be altered with **an unprecedented speed, continuously challenging our adaptively.**
- Technological development has opened **new channels of communication, induced new behavioral patterns,** and influenced organization principles.
- The increasing integration of technology into our lives ***has created unprecedented volumes of data on society's*** everyday behavior.

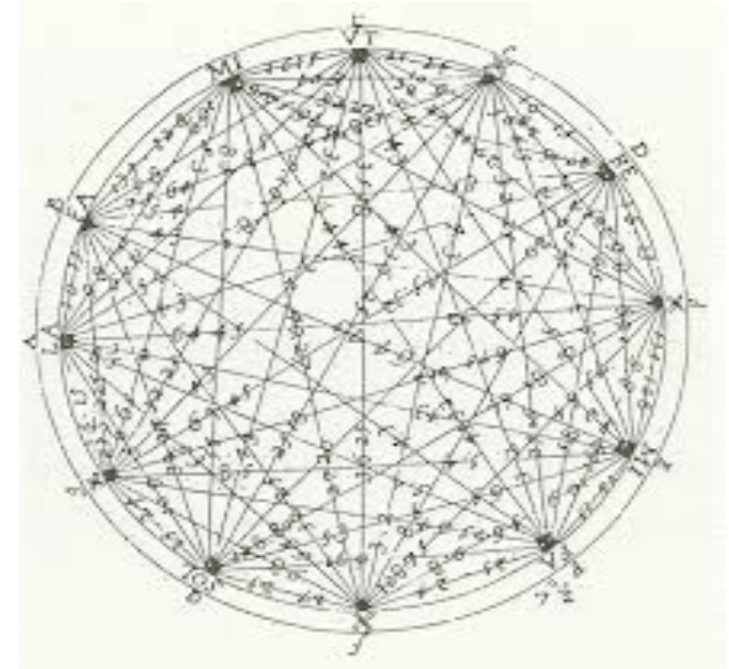


- ◆ Human society has never before changed as fast as it is changing today.
- Such data opens up exciting new opportunities to work towards a quantitative understanding of our complex social systems.
- There is the need for a greater comprehension of the complexity of our interconnected global society and an ability to apply such insights in social decisions.

- Computational social science referring to the **application of numerical methods and simulation** to complex issues of social science research.

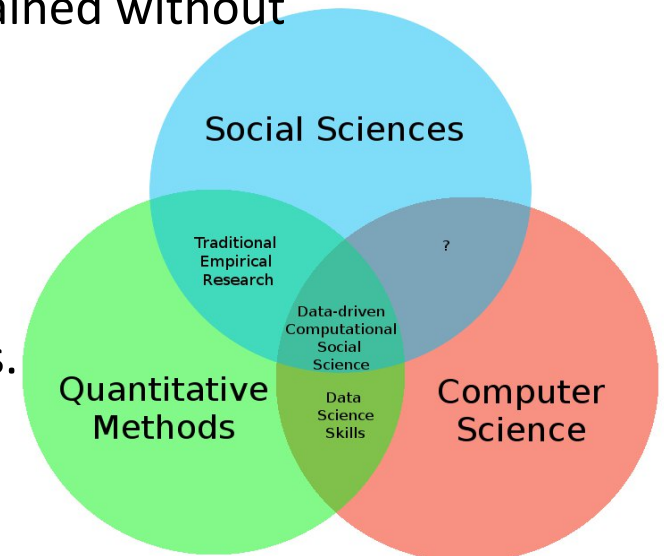
- A big way in which computational methods are **revolutionizing society** is by causing businesses to reinvent their business models.

- Today, **business decisions** depend on high performance analytics, provided by computational methods in social science.



- ◆ Social networks, such as Facebook, Reddit, or Wikipedia, have thousands or millions of users, providing ideal living laboratories to conduct such research.
- This opens up exciting new opportunities to work towards a quantitative understanding of our complex social systems, which will generate many directly/ indirectly jobs.

- Is a **multi-disciplinary** focusing on **information processing by means of advanced IT**, including analysis of social networks and social geographic systems.
- The **more CM are used**, the **clearer that is a powerful tool** in both understanding and discovering a number of phenomena previously unexplained without mathematical analysis.



- **Computers are used** to model, simulate, and analyze:
 - Social sciences like anthropology, demography, etc.
 - Behavioral sciences like psychology and cognitive sciences.
 - Financial areas like financial mathematics, statistics, etc.
- ◆ Computational methods use powerful computer simulations of networks from data collected of interactive lives we lead.
- Handling this data in order to conduct empirical social science research clearly needs data science and other skills.
- CM are digital tools using online experiments involving hundreds of thousands of individuals to answer questions that were previously impossible to investigate.



So how are computational methods actually changing society?



- CMs are visibly moving us towards **more algorithmic and logical modes of tackling problems**, often at the expense of common sense.
- Computational methods are tools of our design that **fit into niches** to solve different problems **in societal mechanisms**:
 - Long-term trends in inequality and mobility can be assessed by linking tax records across years and generations.
 - Social-psychology experiments can be run on Amazon's Mechanical Turk service.
 - Cultural change can be mapped by studying the rise and fall of specific Google search term.
 - Social contagion can be studied by scraping Twitter feeds.
 - Peer effects are tested on Facebook.

ECONOMICS
GEOGRAPHY DESIGN & TECHNOLOGY
PHYSICS COMPUTATIONAL
ENGLISH THINKING CHEMISTRY
HISTORY CBM BIOLOGY MUSIC
MODERN LANGUAGES

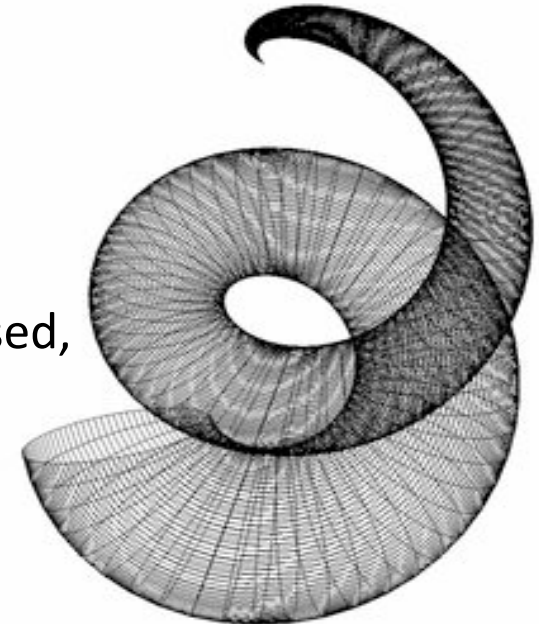
- ◆ Our society has a great collective ability to process information because our communication involves more than words.
- In many ways there has been no better time to be a scholar in sociology, political science, economics, or related fields.

- **Expanding virtual labs**

- Providing infrastructure for large macrosociology studies
- For example, Amazon Mechanical Turk

- **Putting the social back into computational social science**

- Many research papers are heavily computer science focused, and have limited relevance in the field of social science.



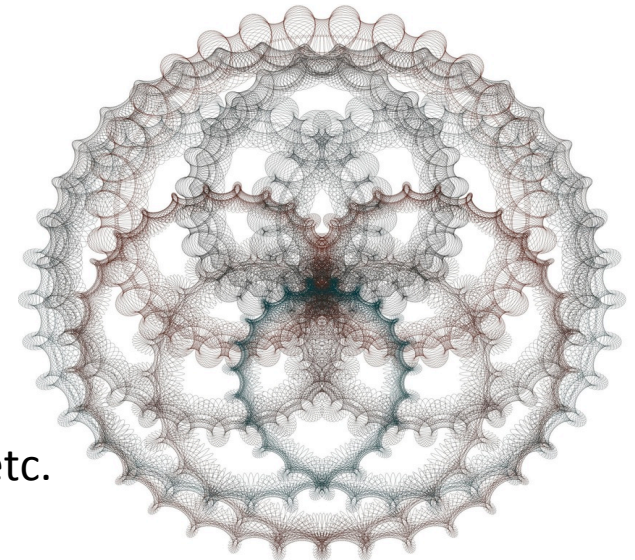
- ◆ **Creating a “social super collider”**

- Solving complex social questions is nowadays quite hard or impossible, because one needs to combine many different sources of typically inaccessible data.

- **Ethical use of information, we must ensure that data is not stolen.**

- Researchers need to be careful when treading in these new waters.
- It's an ongoing challenge to ensure that researchers collect and store the requisite information safely, and that they and others use that information ethically.
- They need to work hard to secure their databases and make sure that hackers don't steal private information.

- This area can **expect to see tremendous growth as professionals** from a number of fields realize the value of mathematical analysis.
 - Today regardless of the size of a business or industry type **there is a need for quality professionals** who can decipher all that unstructured and strategize business goals.
 - Researchers predict that computational and big data **will bring 4.4 million jobs globally**.
- The corporate labour market asks for **data scientists in order to fill the gaps**.
 - Data modelling and analysis, analysing trends, building predictive models, decision making business, etc.
- ◆ Exciting aspect of the computational techniques
 - CM is being using to study many topics: demography, social networks, analysis of conflict, social choice, etc.
- It is an evolutionary step in interdisciplinary fields.
 - Which are highly related: business analysis that incorporate computer science, modelling, statistics, analytics, mathematics, data mining or Knowledge Discovery in Databases, etc.



- **What about the privacy then?**

- CM provides powerful ways to the data study. Even anonymous data have been shown, under some circumstances, to lead back to individuals.

- **It is there room for data science skills in a purely research environment?**

- Many of the mathematical tools, models, approaches, and frameworks to study social and behavioral sciences have only been studied and many have yet to be developed

- **Why is scientists and industry interested computational social science?**

- This ability to collect and analyze massive amounts of social and behavioral data is disrupting and transforming business intelligence, operations, and organization.

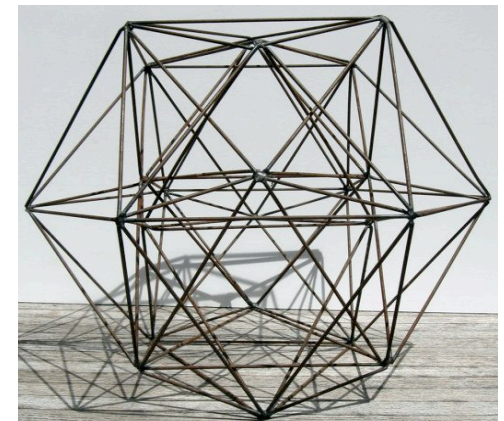
- ◆ **Why is computational social science emerging nowadays?**

- Due to advances in machine learning and computational techniques, and the proliferation of digital footprints, human and societal behavior.
- These aspects were unquantifiable and unobservable, now generates data that can be collected and analyzed to make estimations and predictions.

- **More interdisciplinary cooperation needed!**

- I think the field of Data Science is highly interdisciplinary and influenced by many other fields.

A coordinated public effort is needed to overcome all of these obstacles.





ITELLI - Barcelona, November 2016



Thank you

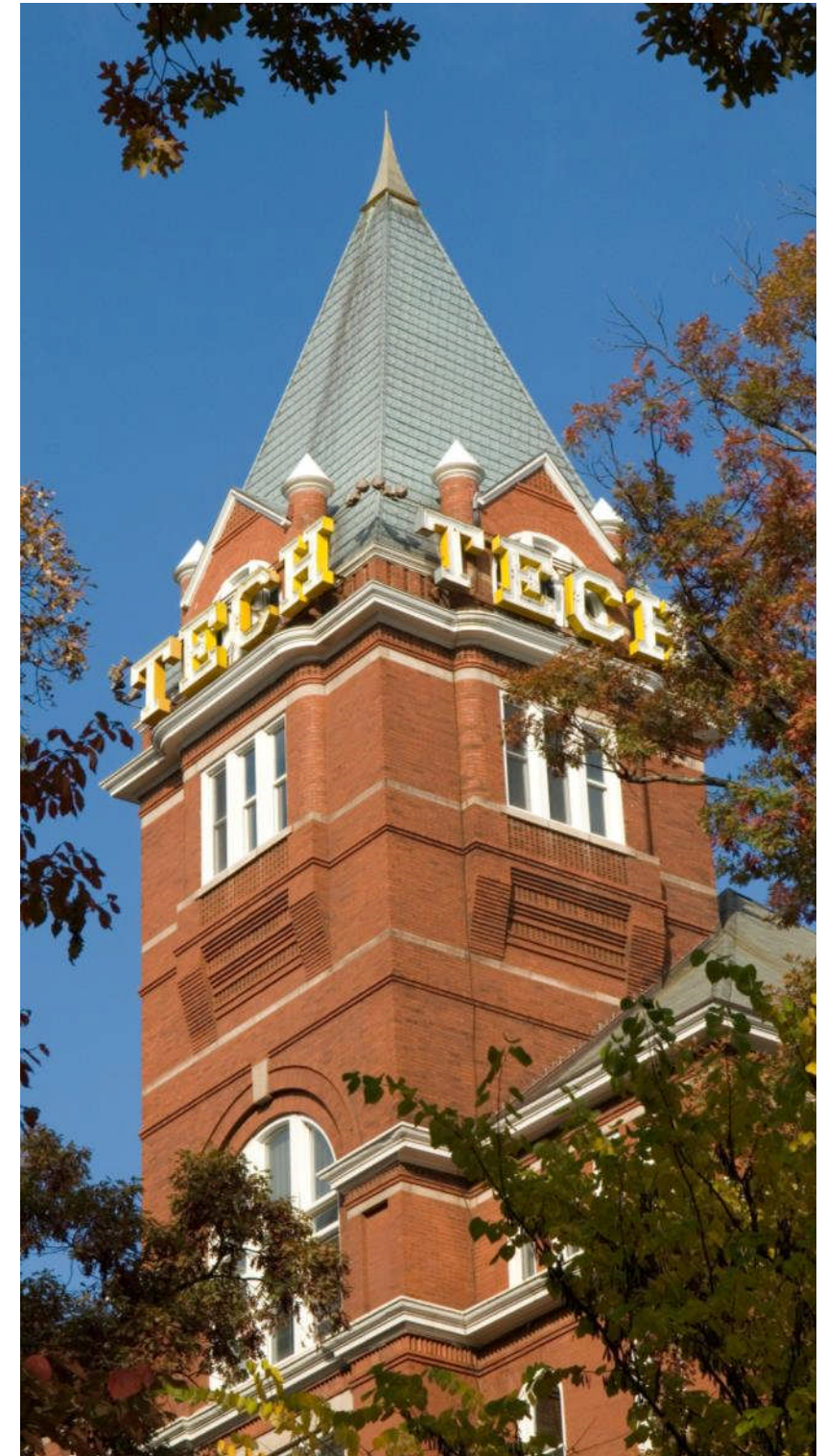
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Dr. Dennis J. Folds

HUSO 2016



New Possibilities from the Internet of Things (IoT)

- Cyber-physical systems tend to be networked and to have on-board computing capabilities that can provide raw and refined data of interest to social scientists
- Reduce reliance on self-report (surveys, logs) to measure social behavior
 - Activities of Daily Living (ADL), plus IADL and EADL
 - Community Mobility
 - Social Connectedness
- Manifest indicators of latent variables of interest (e.g., subjective well being, city satisfaction, confidence in government)
- Collectively, this will allow development of new constructs, measurement methods, and social science theory

Indirect Measures of Social Activity

- Use of position data (from phone/car sources) to track community mobility and visits to points of interest
- Combine this with data on purchases, to calculate indicators of the extent to which a person at medium risk is able to perform IADLs and EADLS
- Example: using data on purchases of gardening supplies, visits to garden store, and amount of time spent in the area used for garden yields an estimate of the level of participation in the hobby of gardening
- Meta data about communications (phone calls, social media participation) can yield useful indicators of social connectedness